"11"

Hydraulics

3rd Year civil

First Term (2009 - 2010)

Chapter (   )

المراجعة النظرى كاملة

المراجعة النظرى
كاملة

Compare Between Each Of :

1. Manning and Chezy Eqs.,
2. Effect of vegetation and roughness on Manning Coeff.,
3. Effect of curvature with large and small radius on Manning Coeff.,
4. Canal and flume,
5. Chute and drops,
6. Shallow wide sec. and narrow deep sec,
7. Efficient sec. and economic sec,
8. Laminar and turbulent flow,
9. Rapidly varied flow and gradually varied flow,
10. Average normal velocity and shear velocity,
11. IR. and IR,
12. Actual shear stress and critical shear stress,
13. A, R, Y, Y_h and Z,
14. Specific energy and total energy,
15. Velocity correction factor and momentum correction factor,
16. Alternative depths and conjugate depths,
17. Specific energy, Specific discharge and Specific force diagrams,
18. Critical, sub-critical and super-critical flow,
19. Ideal and Elastic fluids,
20. Newtonian and Non-Newtonian fluids,
21. Stream line, Streak line, Path line and stream tube,
22. Open channel flow and Pipe flow,
23. Steady and Unsteady flow,
24. Uniform and Non-uniform,
25. Effect of viscosity and effect of gravity,
26. Geometric, kinematics and dynamic similarity,
27. Permissible and critical tractive forces,
28. Dimensionally and non- dimensionally homogeneous,
29. Hydraulically smooth and Hydraulically rough surface and
30. the bed canal slopes.

بسم الله الرحمن الرحيم

Manning eqn.

$$Q = \frac{1}{n} \cdot \frac{A^{5/3}}{P^{2/3}} \cdot S^{1/2}$$

$$V = \frac{1}{n} \cdot R^{2/3} \cdot S^{1/2}$$

Chezy eqn.

$$Q = C \cdot A \cdot \sqrt{R \cdot S}$$ للتصرف

$$V = C \cdot \sqrt{R \cdot S}$$ للسرعة

Effect of vegitation

نستخدم المعامل (N) في معادلة مانج

$$V \cdot R = \frac{1}{N} \cdot R^{7/3} \cdot S^{1/2}$$

Effect of Roughness

نستخدم (n) في معادلة مانج

$$Q = \frac{1}{n} \cdot \frac{A^{5/3}}{P^{2/3}} \cdot S^{1/2}$$

ملحوظة

بزيادة معامل الخشونة للمادة تزداد قيمة (n)

بزيادة غطاء الحشائش داخل القناة تزداد قيمة (N)

Curve with large radius

- بزيادة نصف قطر دوران المنحنى
تقل معامل مانج (n)

Curve with small radius

- نقصان نصف قطر دوران المنحنى
(استخدام منحنيات حادة)
يزداد معامل مانج

Canal

قناة طبيعية

Flume

قناة تستخدم في المعمل

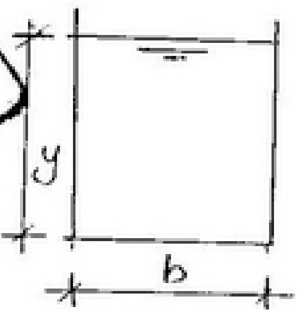
Chute	Drop
قناة ذات ميل حاد وطول قصير نسبياً	انخفاض مفاجئ في قاع القناة في منطقة ما .

shallow wide

$b > 10y$

Narrow deep

$y > 10b$



Efficient section	Economic section
هو القطاع الذي يعطي أقصى تصرف ممكن .	هو القطاع الذي يعطي أقل تكاليف حفر وتكاليف تبطين

Laminar flow	Turbulent flow
حالة السريان عندما تكون فيه رقم رينولد $IR < 500$	حالة السريان عندما تكون فيه $IR > 2000$

Rapidlly varied flow	Gradually varied flow
هو السريان الذي يتغير عمقه بصورة سريعة في مسافة أفقية قصيرة	هو السريان الذي يتغير عمقه تدريجياً على مسافة أفقية طويلة نسبياً .

normal Velocity	shear Velocity
هى قيمه السرعه داخل المجرى المائى والتى لا تسبب حركه لحبيبات التربه.	هى قيمه السرعه داخل القطاع والتى تبدأ عندها حبيبات التربه فى الحركه مع السريان

IR	IR_*
$IR = \frac{V \cdot y}{\nu}$	$IR_* = \frac{V_* \cdot y}{\nu}$
هى رقم رينولد عندما تكون قيمه السرعه داخل القطاع هى السرعه المتوسطه.	هى رقم رينولد عندما تكون قيمه السرعه داخل القطاع هى سرعه القص (shear velocity)

actual shear stress	Critical shear stress
هى قيمه اجهاد القص داخل المجرى والتى لا يترتب عليها حركه لحبيبات التربه داخل المجرى مع السريان	هى أقصى اجهاد قص تتحمله حبيبات التربه داخل القطاع قبل أن تبدأ فى الحركه مع اتجاه السريان

A , R , y	Z , y_h
$R = \frac{A}{P}$	Section Factor
$A = (B + Zy)\,y$	$Z = A\sqrt{y_h}$
$P = B + 2y\sqrt{1+Z^2}$	$y_h = \frac{A}{T}$

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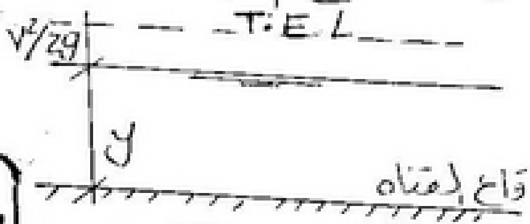
Specific energy

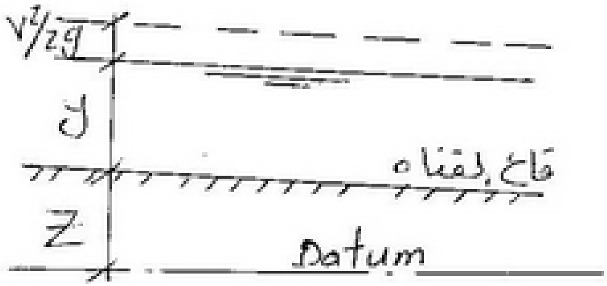
هو قيمة الطاقة الكلية داخل القطاع على اعتبار أن مستوى القياس قاع القناة



$$E = y + \frac{V^2}{2g}$$

Total Energy

هو قيمة الطاقة الكلية داخل القناة مقاسة من مستوى قياسي



$$E = Z + y + \frac{V^2}{2g}$$

Energy Correction Factor

هو معامل تصحيح قيمة السرعة داخل معادلة الطاقة (α)

$$E = y + \frac{\alpha V^2}{2g}$$

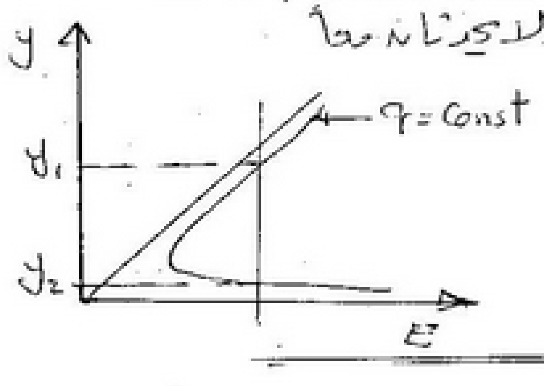
Momentum Correction Factor

هو معامل تصحيح السرعة داخل معادلة كمية التحرك (β)

$$M = \rho \, Q \, . \, \beta . V$$

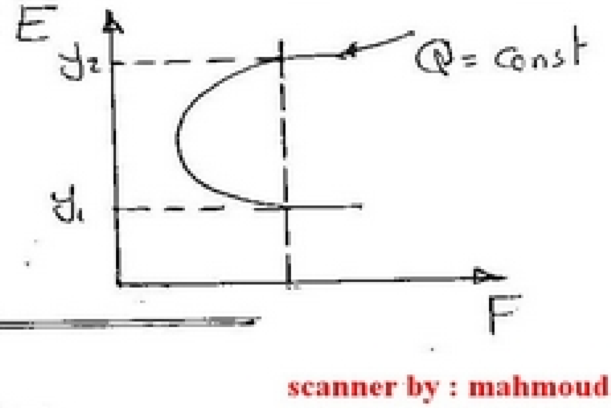
Alternative Depthes

هما العمقان اللذان لهما نفس الطاقة النوعية داخل القطاع عند ثبات التصرف وكلا أحدهما super critical والآخر subcritical ولا يحدثان معا



Conjegate Depthes

هما العمقان اللذان لهما نفس قيمة القوة النوعية داخل القطاع عند ثبات التصرف وكلا أحدهما super critical والآخر subcritical



5- **Critical Flow**

حالة السريان عندما تكون فيها

$F = 1.00$

sub critical flow

حالة السريان عندما تكون فيها

$F < 1$

super critical flow

حالة السريان عندما تكون فيها

$F > 1$

Ideal Fluid

هو السائل الذي ليس له اي مقاومة لقوى القص.

Elastic Fluid

هو السائل الذي له قيمة مقاومة ضد قوى القص ومن الممكن ان يحدث له تشكل تحت تأثير هذه القوى.

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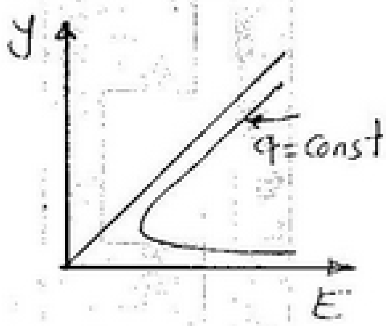
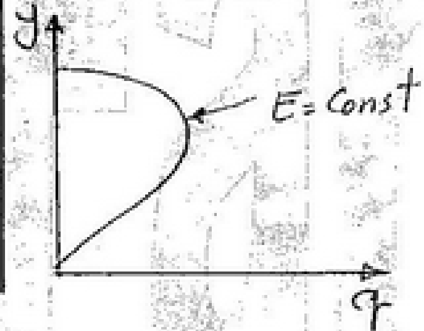
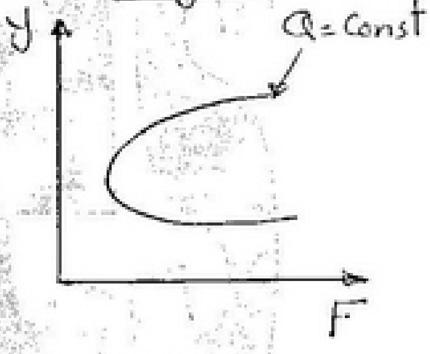
specific energy Diagram



specific discharge diagram



specific Force diagram



Newtonian Fluid

هو السائل الذي لا تتغير لزوجته بتغير التشكل الحادث له

Non - Newtonian Fluid

هو السائل الذي تتغير لزوجته بتغير التشكل الحادث له.

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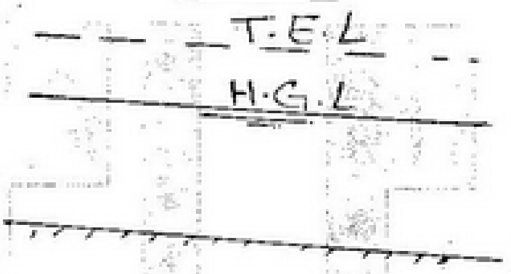
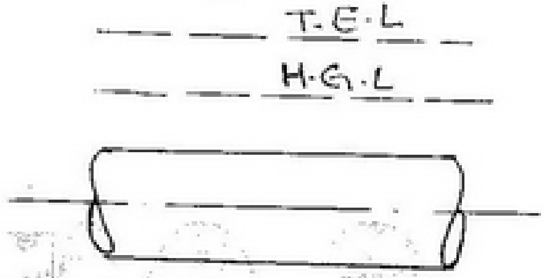
Stream tube	Path line	Streak line	Stream line
هي مجموعة من خطوط السريان والتي تعطي شكل السريان	هو الخط الذي ترسمه حركة جزئ واحد خلال فترة زمنية	هو الخط الذي يصل بين جميع النقاط التي تمر بنقطة ثابتة	هو خط وهمي يعطي شكل السريان والمماس له يعطي اتجاه السرعة

Open channel Flow



١. خشونة القطاع متغيرة.
٢. شكل توزيع السرعات متغير.
٣- ابعاد القطاع متغيرة.
٤- السريان تحت تأثير الجاذبية.

Pipe flow



١- خشونة القطاع ثابتة
٢- شكل توزيع السرعات ثابت.
٣- ابعاد القطاع ثابتة.
٤- السريان تحت تأثير الضغط.

Steady Flow

هو السريان الذي لا تتغير خواصه بتغير الوقت.

$$\frac{\partial y}{\partial t} = 0 \quad , \quad \frac{\partial v}{\partial t} = 0$$

Un steady Flow

هو السريان الذي تتغير خواصه بمرور الوقت

$$\frac{\partial y}{\partial t} \neq 0 \quad , \quad \frac{\partial v}{\partial t} \neq 0$$

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Uniform Flow

هو السريان الذى لا تتغير خصائصه مع المسافة .

$$\frac{\partial y}{\partial x}=0 , \quad \frac{\partial v}{\partial x}=0$$

non_Uniform Flow

هو السريان الذى تتغير خصائصه مع المسافة .

$$\frac{\partial y}{\partial x}\neq 0 , \quad \frac{\partial y}{\partial x}\neq 0$$

Effect of viscocity

يعتمد تأثير اللزوجة على قيمة R

$$R = \frac{V\cdot y}{\nu}$$

Effect of Gravity

يعتمد تأثير الجاذبية على قيمة F

$$F = \frac{V}{\sqrt{g\cdot y}}$$

Geometric similarty

تعتمد هذه المماثلة على نقل الأبعاد بنسبة واحدة

$$L_r = \frac{L_m}{L_p}$$

Kinematic similarty

تعتمد هذه المماثلة على نقل السرعة والتصرف بنفس النسبة

$$V_r = \frac{V_m}{V_p}$$

Dynamic similarty

وتعتمد هذه المماثلة على نقل القوى بنسبة

$$F_r = \frac{F_m}{F_p}$$

Permisible T.F

هى قيمة قوة السحب داخل القطاع والتى لا يحدث معها حركة لحبيبات التربة مع اتجاه السريان .

Critical T.F

هى أقصى قوة سحب داخل المجرى المائى قبل أن تبدأ بعدها حبيبات التربة فى الحركة مع اتجاه السريان

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Dimensionally hemogenous	non - Dimensionally hemogenous
هي المعادلة التي يكون فيها ابعاد الطرفين متساوية	هي المعادلة التي يكون فيها ابعاد الطرفين غير متماثله .

Hydraulically smooth	Hydraulically Rough
عندما تكون الخشونه المكونه لقاع القناه اقل من الخشونه الحرجه	عندما تكون ارتفاع الخشونه داخل المجرى المائي اكبر من الخشونه الحرجه
$K < K_c$	$K > K_c$

Bed canal slopes:

$S_o < S_c$ (Mild slope)

$S_o \quad S_c$ (Critical slope)

$S_o \quad S_c$ (steep slope)

$S_o = 0$ (Horizontal)

$S_o > 0$ (Adverse slope)

Define the Following Parameters :

1. Discharge rating curve,
2. Ultra rapid flow,
3. Types of open channels according to physical poundaries,
4. Best hydraulic section,
5. Dimensions of Chezy coefficient
6. Isovels,
7. Factors affect Manning coefficient,
8. V_*= ------------- = -------------
9. Drag coeff.
10. Potential head,
11. Critical depth line,
12. For critical flow y = --, IF= --, E = --, q = -- and F = --,
13. For super-critical flow y( )Yc, IF( )1.0 and V is ----,
14. for rectangular sec. Yc= ----, Vc= ----- and Emin.= ----,
15. Hydraulic jump,
16. Energy loss through jump,
17. efficiency of the jump,
18. Relative energy loss of the jump,
19. Advantages and disadvantages of modeling,
20. Types of similarity,
21. control section,
22. brink depth, and Yb= ----- Yc
23. Bed canal slopes,
24. Regimes of flow,
25. Sub-critical- Laminar flow,
26. Dimension analysis,
27. Roughness height,
28. Laminar sub-Layer,
29. Incipient motion,
30. Celerity,
31. Total energy line,
32. Dynamic equation of gradually varied flow and
33. Stagnation point.

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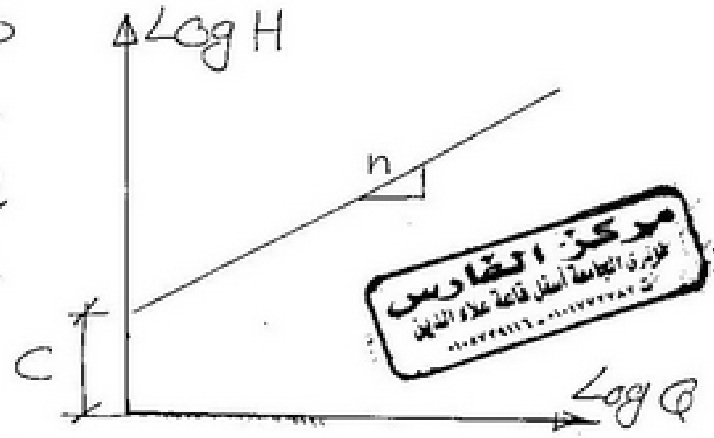
Discharge rating curve

هو منحنى يتم استخدامه لعمل معايرة لجهاز الـ Current meter لمعرفة سرعة السريان بمعرفة عدد لفات الجهاز



Ultra rapid flow: (super critical flow)

هو السريان الذي تكون فيه قيمة $F > 1.0$

Types of canals according to physical boundaries:

1- natural canals قنوات طبيعية

2- Artificial canals قنوات صناعية

Best Hydraulic section:

هو القطاع الذي يعطي أقصى تصرف مع أقل محيط مبتل عند ثبات المساحة.

Dimensions of Chezy Coeff.:

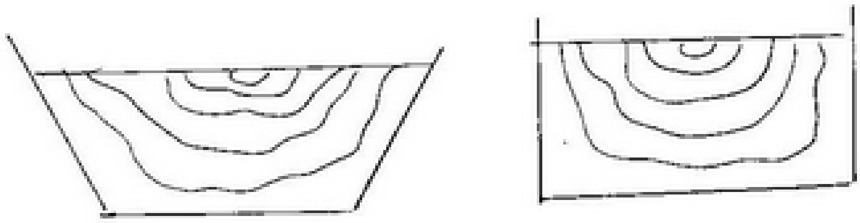
$$\because V = C \cdot \sqrt{R \cdot S}$$

$$\therefore L \cdot T^{-1} = C \times \sqrt{\frac{L^2}{L} \times 1}$$

$$L \cdot T^{-1} = C \cdot L^{1/2} \Rightarrow \boxed{C = L^{1/2} \cdot T^{-1}}$$

Isovels:

هي مجموعة من الخطوط التخيلية التي تربط بين النقاط المتساوية في السرعة (داخل القطاع العرضي للمجرى المائي).



Factors affecting Manning Coeff. (n):

1- surface roughness. خشونة السطح
2- Vegetation. وجود حشائش داخل القطاع
3- Canal irrigularties. عدم انتظام القطاع
4- Canal alignment. تخطيط القناة
5- silting and scouring. النحر والترسيب داخل المجرى
6- obstruction. وجود عوائق داخل المجرى المائي

$$V_* = \sqrt{g \cdot R \cdot S} = \sqrt{\tau_o / \rho}$$

Drag Coeff.:

هي نسبة قوى القص الناتجة من السريان على الحدود الصلبة للقطاع المائي وتؤثر في نفس اتجاه الحركة.

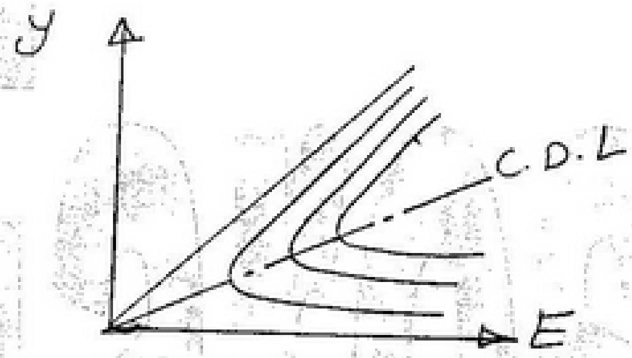
11 **potential head:**

هى عبارة طاقة الوضع للسريان مقاسه من مستوى قياسى (Z)

$$E = \underline{\underline{Z}} + y + \frac{V^2}{2g}$$

Critical depth line:

هو الخط الهندسى الذى تقع عليه كل النقط التى عندها عمق السريان هو العمق الحرج وعليه قيمة $IF = 1.0$



For critical flow:

$y = y_c$, $IF = 1.0$, $E = E_{min} = 1.5\, y_c$

$q = q_{max}$, $F = F_{min.} = 1.5\, y_c^2$

For super critical flow:

$y < y_c$, $IF > 1$, V is max.

For rectangular section:

$y_c = \sqrt[3]{q^2/g}$, $E_{min} = 1.5\, y_c$

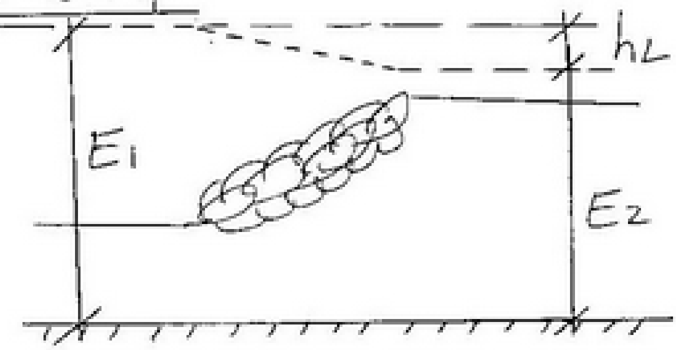
Hydraulic Jump:

هي ظاهره هيدروليكيه تحدث نتيجه انتقال السريان من حاله super critical الى حاله sub critical .

Energy loss througth Jump:

$h_L = E_1 - E_2$

هي مقدار الطاقه التي يتم تشتيتها خلال القفزه



Effeciency of the Jump:

هي قدره القفزه الهيدروليكيه على تشتيت الطاقه داخلها

$$\eta = \frac{E_2}{E_1}$$

Relative energy loss of Jump:

هي النسبه بين الطاقه المشتته داخل القفزه الهيدروليكيه و الطاقه الابتدائيه للقفزه

$$\frac{h_L}{E_1}$$

Advantages of modeling	Disadvantage
١- اكتشاف عيوب المنشأ .	١- عمل النماذج مكلف
٢- توفير تكاليف الانشاء .	٢- بعض القوى لا يمكن تمثيلها معملياً مثل الرطوبه - الزلازل - ....
٣- دراسة حالات تحميل معقده	

13

Types of similarity:

1- geometric similarity.
2- Kinematic similarity.
3- Dynamic similarity.

Control section:

هو القطاع الذى عنده تكوين العمق الحرج للماء داخله ويستخدم فى قياس التصرف.

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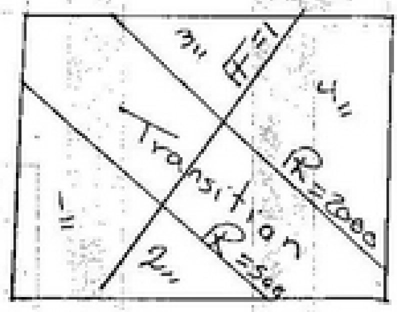
* Brick depth $y_b = 0.7\, y_c$

Regimes of flow:



هى طريقة تستخدم لتصنيف انواع السريان اعتماداً على IR ، IF فى نفس الوقت

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sub critical Laminar Flow:

هو السريان الذى يكون فيه

$IF < 1$

$IR < 500$

14

Dimension analysis:

هي طريقة تستخدم لربط المتغيرات المختلفة المؤثرة على ظاهرة ما وايجاد العلاقات بين هذه المتغيرات.

Roughness height:

هو مقدار ارتفاع الخشونة المكونة لجوانب وقاع المجاري المائية.

Laminar sub layer:

هي طبقة من السريان بالقرب من قاع القناة وفيها يكون السريان شرائحي.

Incipient motion:

هي بداية حركة حبيبات التربة داخل القناة وتبدأ عندما تصل قيمة قوة السحب داخل المجرى المائي إلى القيمة الحرجة.

Celerity:

هي سرعة انتقال الموجة في المياه الضحلة

$$V = \sqrt{g \cdot y}$$

Total energy Line:

هو خط يبين قيمة الطاقة الكلية داخل المجرى المائي عند أي قطاع.

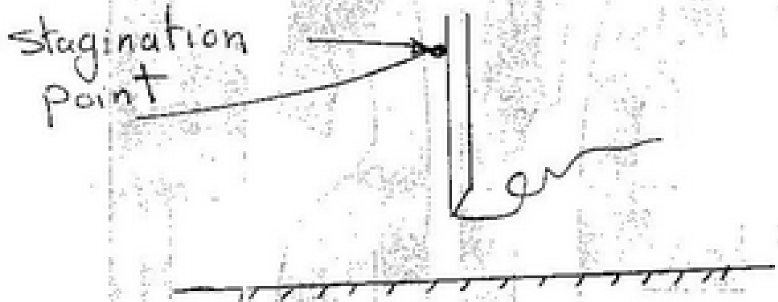
Dynamic equation of G.V.F:

هى المعادلة التى تستخدم لإيجاد العلاقة بين عمق الماء وتغيره مع المسافة الأفقية ويمكن وضعها فى عده صور منها .

$$\frac{dy}{dx} = \frac{S_o - S_e}{1 + \frac{V^2}{2g}\frac{d}{dy}}$$

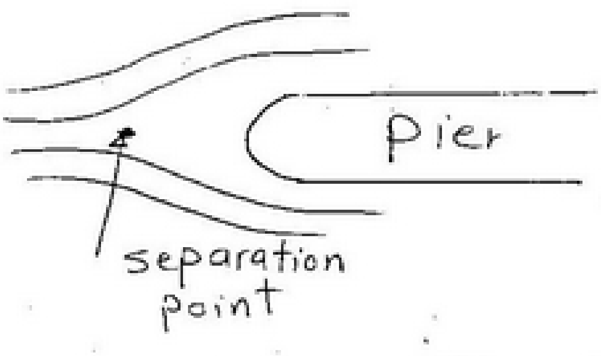
Stagination point:

هى النقطة التى تقل عندها سرعه السريان إلى الصفر وتحدث امام البوابات



Separation point:

هى النقطة التى يبدأ عندها انفصال خطوط السريان وتحدث امام بغال الكبارى.



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Velocity Head:

هو جزء من الطاقة ينتج من انتقال السريان بسرعة مقدارها (V) وقيمته $\left(\frac{V^2}{2g}\right)$

Relative initial depth:

هو النسبة بين العمق الابتدائي للقفزة الهيدروليكية والطاقة عند بداية القفزة (y_1/E_1)

Dimension of Manning Coeff.:

$$\therefore V = \frac{1}{n} \cdot R^{2/3} \cdot S^{1/2}$$

$$L \cdot T^{-1} = \frac{1}{n} \cdot \left(\frac{L^2}{L}\right)^{2/3} \cdot 1$$

$$L \cdot T^{-1} = \frac{1}{n} \cdot L^{2/3}$$

$$\therefore n = \frac{L^{2/3}}{L \cdot T^{-1}}$$

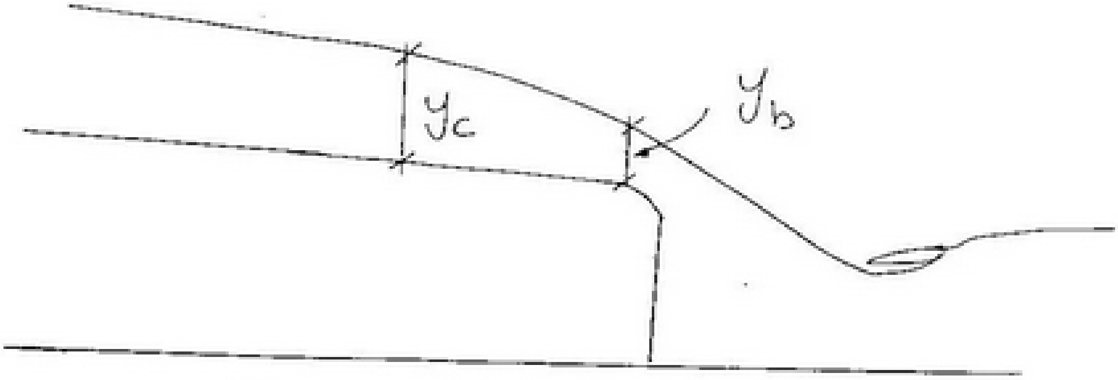
$$\boxed{n = L^{-1/3} \cdot T}$$

Current meter:

هو جهاز يستخدم لتحديد سرعة الماء داخل القنوات المائية .

---

17 How a brink measure the discharge:



$\because \quad y_c = 0.7\, y_b$

بمعلوميه y_b علينا ايجاد قيمه y_c

$\because \quad y_c^3 = q^2/g$

علينا ايجاد q بمعلوميه y_c

$Q = q \times B$

Oefferent Models

Compare Between Each Of :

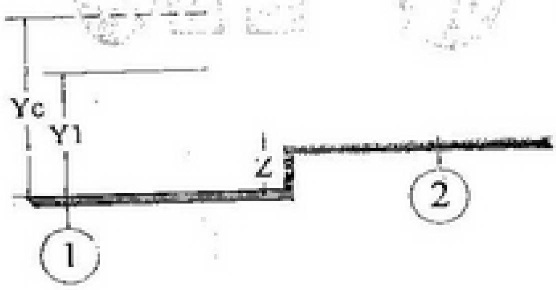
1. Effect of vegetation and roughness on Manning Coeff.,
2. Effect of curvature with large and small radius on Manning Coeff.,
3. Chute and drops,
4. Shallow wide sec. and narrow deep sec,
5. Efficient sec. and economic sec,
6. Rapidly varied flow and gradually varied flow,
7. IR_* and IR,
8. A, R, Y, Y_h and Z,
9. Specific energy and total energy,
10. Alternative depths and conjugate depths,

Define the Following Parameters :

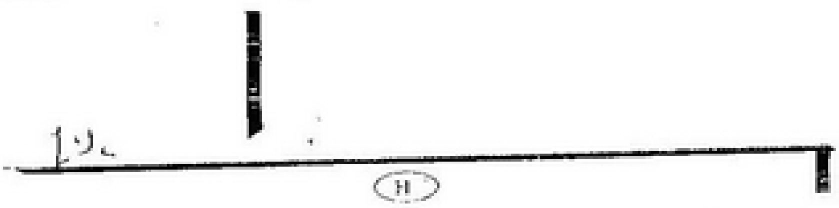
1. Discharge rating curve,
2. Ultra rapid flow,
3. Types of open channels according to physical boundaries,
4. Best hydraulic section,
5. Dimensions of Manning coefficient,
6. Isovels,
7. Factors affect Manning coefficient,
8. V_*= ------------- = -------------
9. Drag coeff.
10. Potential head,

Give Neat Sketch For Each Case :

1. The relationship between Y1 and Y2 and Z,



2. The water surface profile



Compare Between Each Of :

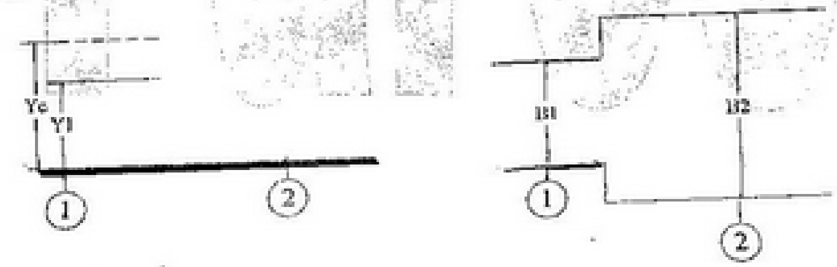
1. Chute and drops,
2. Shallow wide sec. and narrow deep sec,
3. Efficient sec. and economic sec,
4. IR, and IR,
5. Actual shear stress and critical shear stress,
6. Specific energy, discharge and force diagrams,
7. Ideal and Elastic fluids,
8. Open channel flow and Pipe flow,
9. Effect of viscosity and effect of gravity on the flow,
10. Geometric, kinematics and dynamic similarity,

Define the Following Parameters :

11. Regimes of flow,
12. Sub-critical- Laminar flow,
13. Dimension analysis,
14. Roughness height,
15. Laminar sub-Layer,
16. How a brink can be measure the discharge,
17. Celerity,
18. Total energy line,
19. Dynamic equation of gradually varied flow and
20. Stagnation point.

Give Neat Sketch For Each Case :

1. The relationship between Y1 and Y2 and B2,



2. The water surface profile

Compare Between Each Of :

1. Normal velocity and shear velocity,
2. IR. and IR,
3. Actual shear stress and critical shear stress,
4. Specific energy and total energy,
5. Velocity correction factor and momentum correction factor,
6. Alternative depths and conjugate depths,
7. Critical, sub-critical and super-critical flow,
8. Ideal and Elastic fluids,
9. Newtonian and Non-Newtonian fluids,
10. Open channel flow and Pipe flow,

Define the Following Parameters :

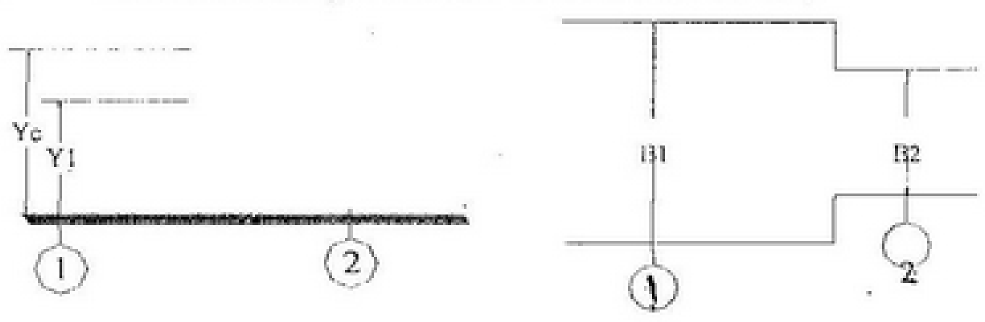
1. For critical flow y = --, IF= --, E = --, q = -- and F = --,
2. Energy loss through jump,
3. Relative initial depth of the jump,
4. Types of similarity,
5. control section,
6. brink depth, and Yb= ----- Yc
7. Bed canal slopes,
8. Current meter,
9. Regimes of flow,
10. Sub-critical- Laminar flow,

Give Neat Sketch For Each Case :

1- The pressure inside the pizometer for each case,

Convex Concave

3. The relationship between Y1 and Y2 and B2,



Compare Between Each Of :

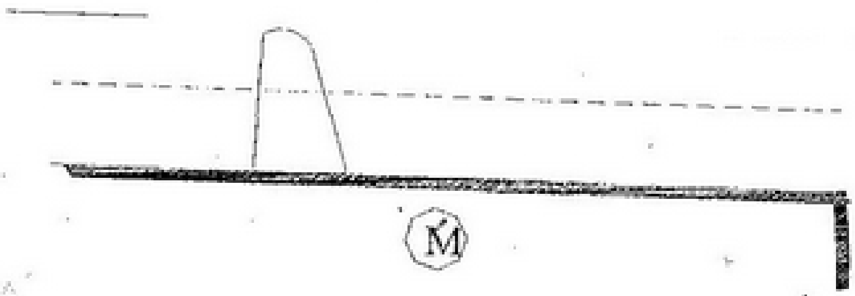
1. Manning and Chezy Eqs.,
2. Canal and flume,
3. Efficient sec. and economic sec,
4. Normal velocity and shear velocity,
5. Specific energy and total energy,
6. Specific energy, discharge and force diagrams,
7. Newtonian and Non-Newtonian fluids,
8. Effect of viscosity and effect of gravity on the Flow,
9. Dimensionally and non- dimensionally homogeneous,
10. Hydraulically smooth and Hydraulically rough surface and

Define the Following Parameters :

1. Discharge rating curve,
2. Best hydraulic section,
3. Dimensions of Manning coefficient,
4. Drag coeff.
5. Potential head,
6. critical depth line,
7. For critical flow y = --, IF= --, E = --, q = -- and F = --,
8. for rectangular sec. Yc= ----, Vc= ----- and Emin.= ----,
9. Relative energy loss of the jump,
10. Advantages and disadvantages of modeling.

Give Neat Sketch For Each Case :

4. The water surface profile



Compare Between Each Of :

1. Chute and drops,
2. Shallow wide sec. and narrow deep sec,
3. Laminar and turbulent flow,
4. Rapidly varied flow and gradually varied flow,
5. Actual shear stress and critical shear stress,
6. Velocity correction factor and momentum correction factor,
7. Alternative depths and conjugate depths,
8. Specific energy, discharge and force diagrams,
9. Critical, sub-critical and super-critical flow,
10. Ideal and Elastic fluids,

Define the Following Parameters :

1. Ultra rapid flow,
2. Types of open channels according to physical poundaries,
3. Isovels,
4. Factors affect Manning coefficient,
5. Velocity head,
6. For super-critical flow y( )Yc, IF( )1.0 and V is ----,
7. Hydraulic jump,
8. Jump height,
9. efficiency of the jump,
10. Relative initial depth of the jump,

Give Neat Sketch For Each Case :

1. The water surface profile

C

S

Compare Between Each Of :

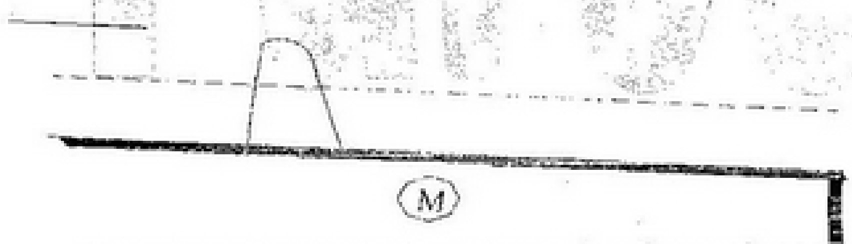
1. Effect of vegetation and roughness on Manning Coeff.,
2. Canal and flume,
3. Shallow wide sec. and narrow deep sec,
4. Laminar and turbulent flow,
5. Average normal velocity and shear velocity,
6. Actual shear stress and critical shear stress,
7. Specific energy and total energy,
8. Alternative depths and conjugate depths,
9. Ideal and Elastic fluids,
10. Stream line, Streak line, Path line and stream tube,

Define the Following Parameters :

1. Types of open channels according to physical boundaries,
2. Dimensions of Chezy coefficient
3. Isovels,
4. Critical depth line,
5. For critical flow y = --, IF= --, E = --, q = -- and F = --,
6. For super-critical flow y( )Yc, IF( )1.0 and V is ----,
7. for rectangular sec. Yc= ----, Vc= ----- and Emin.= ----,
8. brink depth, and Yb= ----- Yc
9. Bed canal slopes,
10. Regimes of flow,

Give Neat Sketch For Each Case :

1. The water surface profile



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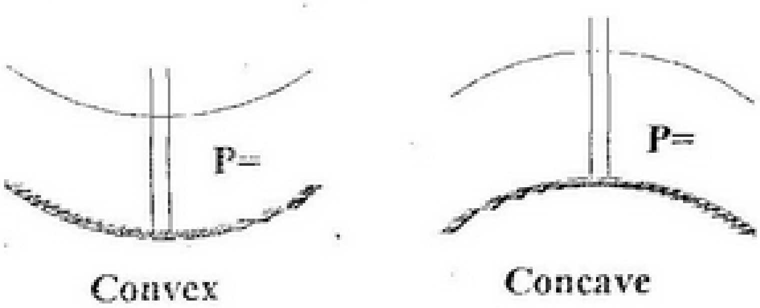
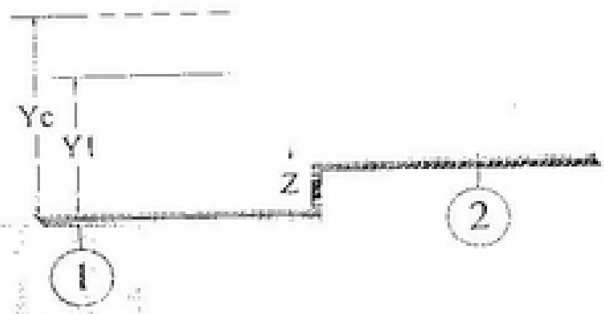
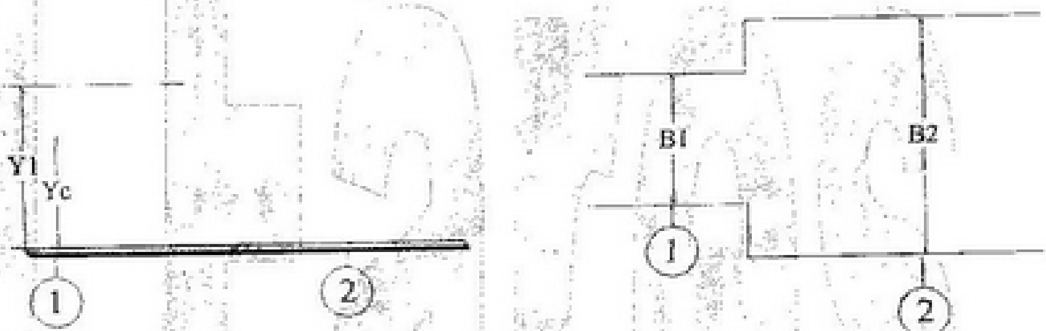


Give Neat Sketch For Each Case :

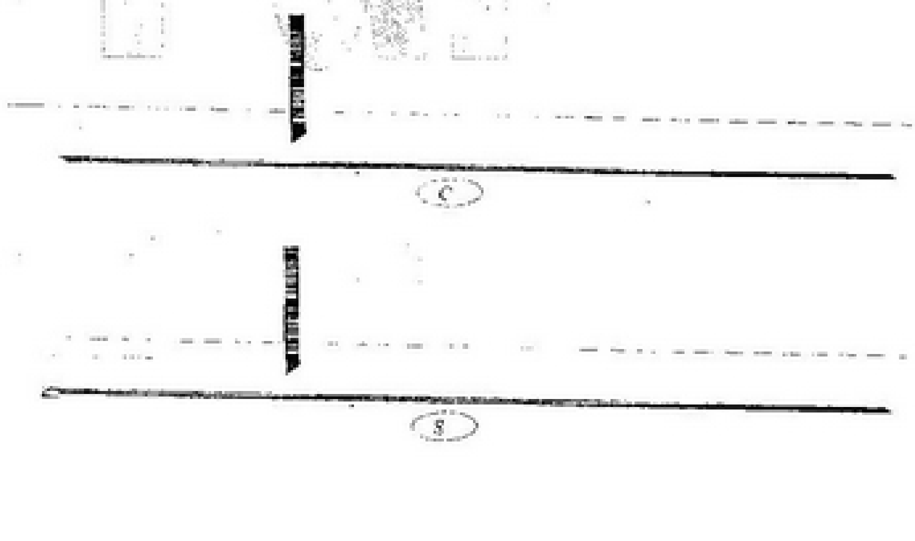
1. The relationship between Y1 and Y2 and Z,



2. The relationship between Y1 and Y2 and B2,



4. The water surface profile



Compare Between Each Of :

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3. Chute and drops,
4. Shallow wide sec. and narrow deep sec,
5. IR. and IR,
6. A, R, Y, Y_h and Z,
7. Stream line, Streak line, Path line and stream tube,
8. Open channel flow and Pipe flow,
9. Geometric, kinematics and dynamic similarity,
10. Permissible and critical tractive forces,
11. Dimensionally and non- dimensionally homogeneous,
12. Hydraulically smooth and Hydraulically rough surface and
13. the bed canal slopes.

Define the Following Parameters :

1. Discharge rating curve,
2. Ultra rapid flow,
3. Types of open channels according to physical poundaries,
4. Best hydraulic section,
5. Dimensions of Chezy coefficient
6. Isovels,
7. Factors affect Manning coefficient,
8. V_*= ------------ = ------------
9. Drag coeff.
10. Potential head,
11. Critical depth line,
12. For critical flow y = --, IF= --, E = --, q = -- and F = --,
13. For super-critical flow y( )Yc, IF( )1.0 and V is ----,
14. for rectangular sec. Yc= ----, Vc= ----- and Emin.= ----,
15. Hydraulic jump,
16. Energy loss through jump,
17. efficiency of the jump,
18. Relative energy loss of the jump,
19. Advantages and disadvantages of modeling,
20. Types of similarity,

10/15

MCQ on Open-Channel Flow

1. Open-channel flows have a pressure force driving the fluid similar to pipe flows. True or False
   - A. True
   - B. False

2. Where did the greatest difference between high and low tide occur?
   - A. The Bay of Fundy, Canada
   - B. Lundy's Lane, Canada
   - C. The coast of Maine, U.S.A.

3. Open channel flow can have more than one characteristic. True or False
   - A. True
   - B. False

4. The surface of a lake or ocean is often distorted into changing patterns associated with ____.
   - A. Evaporation
   - B. Uniform flow
   - C. Surface waves

5 missing

6. The speed of a small amplitude, solitary wave is proportional to the ____ of the fluid depth.

   Answer: square root

7. The wave speed can be obtained from the continuity and energy equations. True or False
   - A. True

B. False

8. What does the term *c* represent in wave equations?

A. Wave depth

B. Wave speed

C. Amplitude

9. How is wave speed measured?

A. Relative to the flow

B. Relative to a fix position on the ground

C. Relative to the acceleration of the wave

10. What assumption is made about the slope of the channel bottom in most open channel flows?

A. The surface is rough.

B. The slope is assumed to be constant.

C. The slope is assumed to be negative

1. According to the specific energy diagram, how many possible depths, with some physical meaning, are there for given flow rate and specific energy, assuming $E > E_{min}$?

A. One

B. Two

C. Three

. The rate of change of the fluid depth depends on the local ____ of the channel bottom, the ____ of the energy line, and the Froude number.

Answer:

slope , slope

13. How is uniform depth flow achieved?

- A. By adjusting the bottom slope to equal the slope of the energy line.
- B. By adjusting the flow speed so that it equals the energy line
- C. By ensuring uniform laminar flow

14. The wetted perimeter includes the free surface for open-channel flows. True or False

- A. True
- B. False

15. Where does the wall shear stress act in open-channel flow?

- A. Along the entirety of the flow.
- B. On the wetted perimeter.
- C. Only on the free surface

16. The velocity profile in an open channel is uniform. True or False

- A. True
- B. False

17. Are most open-channel flows laminar or turbulent?

Answer: Turblent

18. The Manning equation is used to obtain the ____ or flow rate in an open channel.

- A. Flow rate
- B. Density
- C. Velocity

19. The value of the Manning coefficient, n, depends on what?

A. The nature of the channel surface

B. The mass flow rate of the flow

C. The type of fluid

20. What shape provides the best hydraulic cross section for open-channel flows?

A. A circular pipe

B. A semicircular channel

C. A triangular channel

21. What three classifications are open-channel flows divided into?

Answer:

uniform depth, gradually varying
rapidly varying

22. How many different surface shape designations are there for free surface calculations?

Answer:

12

23. On what two factors does the free surface shape depend on?

Answer:

The channel bottom slope and
The Froude number

24. What is the technical term for a discontinuity in the free surface elevation of channel flow?

A. A hydraulic jump

B. A rectangular channel

C. Rapidly varied flow

25. What is the primary cause of the head loss that occurs across a hydraulic jump?

A. An increase in flow depth

B. Turbulent mixing

C. A change in momentum

26. What function of the upstream flow dictates the depth ratio across a hydraulic jump?

A. The mass flow rate

B. The velocity of the flow

C. The Froude number

27. The length of a hydraulic jump can be determined analytically. True or False

A. True

B. False

28. What are the two main mechanisms governing the flow over a weir?

Answer:
inertia and gravity

29. What happens to the velocity of the flow as it passes over a broad-crested weir?

A. It decelerates

B. Nothing

C. The flow accelerates and reaches critical condition.

MCQ on Dimensional Analysis, Similitude, and Modeling

1. The pressure drop per unit length that develops due to friction cannot generally be solved analytically.

   A. ~~True~~

   B. False

2. A qualitative description of physical quantities can be given in terms of ____.

   Answer:

   Basic Dimension

3. Dimensional analysis is the when the results of an equation will be what in relation to the system of units chosen.

   A. ~~Dependent~~

   B. Independent

   C. Constant

4. Dimensional analysis is based on the ____.

   Answer:

   Buckingham pi Theorem

5. The dimensions of the variable on the left side of the equation must be ____ the dimensions of any term that stands by itself on the right side of the equal sign.

   A. ~~Greater than~~

   B. Equal to

   C. Fewer than

6. The required number of pi terms is what compared to the number of original variables?

   A. Greater than

B. Equal to

C. Fewer than

7. The most difficult step in the method of repeating variables is ____.

A. Listing all of the variables that are involved in the problem

B. Express each of the variables in terms of basic dimensions

C. Determine the required number of pi terms

8. The number of variables is desired to be kept to a minimum so that the amount of ____ can be kept to a minimum.

Answer:

Laboratory work

9. When using the repeating variables method, the number of repeating variables that are selected should be what compared to the number of reference dimensions?

A. Greater than

B. Equal to

C. Less than

10. The pi terms must always be what?

A. Negative

B. Equal in dimensions

C. Dimensionless

11. How many steps are there in the method of repeating variables?

Answer:

8

12. If too many pi terms appear in the final solution then the problem may be difficult, time consuming, and ____ to eliminate these experimentally.

Answer:

Expensive

13. Variables can be classified into three general groups: geometry, material properties, and external effects.

A. True

B. False

14. An external effect is used to denote any variable that produces or tends to produce what?

A. Inaccurate results

B. Constant results

C. Change in the system

15. How many different points are there to consider in the selection of variables?

A. 3

B. 6

C. 8

16. Typically, in fluid mechanics the required number of reference dimensions is ____.

Answer:

Three

17. Where does any other set of pi terms besides the original set come from?

Answer:

Mam pulation of acorrected set of terms

18. The number of required pi terms is fixed in accordance with the pi theorem.

A. True

B. False

19. How many restrictions are there for pi terms?

A. None

B. ~~Two~~

C. Three

20. Pi terms can be formed by inspection by simply making use of the fact that each pi term must be dimensionless.

A. True

B. False

21. Which of the following is equivalent to the repeating variable method?

A. Forming pi terms by inspection

B. Forming pi terms by dimensional analysis

C. Determination of reference dimensions

22. A useful physical interpretation can often be given to dimensionless groups.

A. True

B. False

23. Write the Reynolds number equation.

Answer:

$Re = \frac{\rho V L}{\mu}$

24. What is the symbol for the Cauchy number?

A. Cn

B. Ca

C. Cu #

25. The Weber number is a relationship between the inertial force and what other force?

A. Surface tension

B. Kinetic

C. Frictional

26. Flows with very small Reynolds numbers are commonly referred to as "____".

Answer:

creeping flows

27. The Euler number is undoubtedly the most famous dimensionless parameter in fluid mechanics.

A. True

B. False

28. The Mach number and what other number cannot be used in the same problem?

A. Euler number

B. Reynolds number

C. Cauchy number

29. The flow of river water is significantly affected by surface tension.

A. True

B. False

30. The fewer the number of pi terms the more simple the problem.

A. True

B. False

31. For problems involving only two pi terms, results of an experiment can be conveniently presented in ____.

Answer:

A simple graph

32. For complicated problems it is often less feasible to use models to predict specific characteristics of the system than to develop general correlations.

A. True

B. False

33. A representation of a physical system that may be used to predict the behavior of the system in some desired respect is what?

A. Prototype

B. Model

C. Facsimile

34. Model design conditions are also called similarity requirements or modeling laws.

A. True

B. False

35. The second similarity requirement indicates that the model and the prototype must be operated at ____.

Answer:

The same Reynolds' number

36. When velocity ratios and acceleration ratios are constant throughout the flow field, kinematic similarity exists between the model and the prototype.

A. True

B. False

37. For true models, how many scales will there be?

A. None

B. One

C. As many as needed

38. Models for which one or more of the similarity requirements are not satisfied are called ____ models.

Answer:

Distorted

39. Distorted models cannot be successfully used, only true models can be accurately used.

A. True

B. False

40. Geometric and Reynolds number similarity is usually not required for models involving flow through closed conduits.

A. True

B. False

41. For large Reynolds numbers, the inertial forces are ____ the viscous forces?

A. Less than

B. Approximately the same as

C. Larger than

42. For a Length Scale of 1/10 and a prototype velocity of 30 mph, what is the required model velocity?

Answer:

300mpH

43. How do the dimples on a golf ball effect drag?

- A. they reduce drag
- B. they increase drag
- C. they do not effect drag

44. When the Mach number becomes greater than approximately ____, the influence of compressibility becomes significant.

Answer:

0-3

45. Flows in canals, rivers, spillways, and stilling basins are all examples of flows with a free surface.

- A. True
- B. False

46. At temperatures of –20 °F, what is the ice growth rate that can be achieved.

- A. 1-mm per hour
- B. 2-mm per hour
- C. 3-mm per hour

47. The drag on a ship depends on both the Reynolds number and the Froude number.

- A. True
- B. False

48. Similarity laws can be directly developed from the ____ governing the phenomenon of interest.

Answer:

Equation

49. For time-dependant problems, which of the following is crucial for successfully finding a solution?

A. The derivative of the equation

B. Initial conditions

C. The velocities at all points

50. Governing equations expressed in terms of dimensionless variables lead to the appropriate dimensionless groups.

A. True

B. False

51. The Froude number arises because of the inclusion of what in a problem?

A. Pressure

B. Velocity

C. Gravity

52. From this section it can be concluded that for the steady flow of a compressible fluid without free surfaces, dynamic and kinematic similarity will be achieved.

A. True

B. False

Final Exam of Hydraulics 2009

Question (1)

A)

Hydraulically smooth	Hydraulically roughness
1- Roughness don't effecting on velocity distribution 2-K<§o $\frac{u_* * k}{\nu} \prec 5$ $U = 2.5U_* \ln \frac{9yU_*}{\nu}$	1- Roughness effecting on velocity distribution 2-K>§o $\frac{u_* * k}{\nu} \succ 5$ $U = 2.5U_* \ln \frac{30y}{k}$
Best hydraulic section	**Stable section**
- Its section is passing maximum discharge for minimum wetted perimeter at constant manning coefficient, water area and longitudinal slope.	-Its section not permissible to scouring or silting.
Friction velocity(shear velocity)	**Mean flow velocity**
Its maximum velocity in channel before the particle of side and bed to move. $U_* = \sqrt{gRS}$	Q=A*V Q=discharge m3/s A water area V Mean flow velocity m/s
State of flow	**Regime of flow**
When we study behavior of flow according to **1-effect of viscosity** $IR = \frac{V * R}{\upsilon}$ IR≤500 flow is laminar 500<IR≤2000 flow is transitional IR>500 flow is turbulent **1-effect of gravity** $FI = \frac{V}{\sqrt{g * y_h}}$ FI<1 flow is sub critical FI=1 flow is critical FI>1 flow is super critical	When we take effect of gravity and viscosity the flow classified in the following cases 1-IR<500 & FI<1 flow is laminar-sub critical 2- IR<500 & FI >1 flow is laminar-superb critical 3- IR>2000 & FI <1 flow is turbulent-sub critical 4- IR>2000 & FI >1 flow is turbulent –super critical

Given

A.S =65,000 fed & W.D=56 m^3/fed/day
S=10cm/km & Z=1.00
n=0.025
Trapezoidal section

Req

Design of sec for the following cases

1- V_{max}=0.58 m/s
2- ζ (max shear stress)=0.22kg/m^2

Solutions

a) For maximum velocity

$$Q=\frac{A.S*W.D}{24*60*60}=\frac{65{,}000*56}{24*60*60}=42.13.....m^3/_{sec}$$

$$Q=A*V..................A=\frac{Q}{V}=\frac{42.13}{0.58}=72.64....m^2$$

$$A=y(b+zy)=72.64.................y(b+1*y)=72.64......................1$$

-----By using manning equation

$$Q=\frac{1}{n}*\frac{A^{\frac{5}{3}}}{P^{\frac{2}{3}}}*S^{\frac{1}{2}}...m^3/_{sec}.........................42.13=\frac{1}{0.025}*\frac{(72.64)\frac{5}{3}}{\left(b+2y\sqrt{1+z^2}\right)^{\frac{2}{3}}}*\left(10*10^{-5}\right)^{\frac{1}{2}}$$

$$b+2y\sqrt{1+(1)^2}=41.605....................................b=41.605-2.83y......................2$$ **Sub in 1**

$$72.64=y(41.605-2.83y+y)............................72.64=41.605y-1.83y^2$$

$$y^2-22.73y+39.694=0.00$$

Get y=1.906 m & b=36.21m

b) For maximum shear stresses

ζ (max shear stress)=0.22kg/m^2
ζ =γ*R*S
0.22 =1000*R*10*10^{-5} ……………………R =2.2m

$$V=\frac{1}{n}*R^{\frac{2}{3}}*S^{\frac{1}{2}}...m^3/_{sec}.......................V=\frac{1}{0.025}*(2.2)^{\frac{2}{3}}*\left(10*10^{-5}\right)^{\frac{1}{2}}$$

V=0.667m/s

$$Q = A*V.................A = \frac{Q}{V} = \frac{42.13}{0.667} = 62.23....m^2$$

-----By using manning equation

$$Q = \frac{1}{n}*\frac{A^{\frac{5}{3}}}{P^{\frac{2}{3}}}*S^{\frac{1}{2}}...m^3/\sec........................42.13 = \frac{1}{0.025}*\frac{(62.23)\frac{5}{3}}{\left(b+2y\sqrt{1+z^2}\right)^{\frac{2}{3}}}*\left(10*10^{-5}\right)^{\frac{1}{2}}$$

$$b+2y\sqrt{1+(1)^2} = 28.38..................................b = 28.38-2.83y.......................2$$ **Sub in 1**

$$62.27 = y(28.38-2.83y+y)..............................62.274 = 28.385y-1.83y^2$$

$$y^2-15.44y+34.03 = 0.00$$

Get y=2.663 m & b=20.84m

-To compare excavation cost

1-By using max velocity

$$A = 72.64.........m$$

2-By using max shear stress

$$A = 62.23....m^2$$

The cost of excavation in design by max excavation more than design by max shear stress

-To show regime of flow

1-By using max velocity

$$y_h = \frac{A}{T} = \frac{72.64}{(36.21+2*1.000*1.9063)} = \frac{42.64}{40.0226} = 1.0654m$$

$$FI = \frac{V.}{\sqrt{g*y_h}} = \frac{[0.58]}{\left[\sqrt{9.81*1.0654}\right]} = 0.179 \prec 1.00.................sub....critical...flow$$

$$R = \frac{A}{P} = \frac{72.64}{\left[36.21+2*1.906\sqrt{1+(1.00)^2}\right]} = \frac{68.6133}{41.6018} = 1.649$$

$$IR = \frac{V*R}{\upsilon} = \frac{(0.58)*(1.649)}{1*10^{-6}} = 956,586.35 \succ 2000...............turbulent...flow$$

Flow is sub critical turbulent

1-By using max shear stress

$$y_h = \frac{A}{T} = \frac{62.23}{(20.84 + 2 * 1.000 * 2.663)} = \frac{42.64}{26.166} = 1.63m$$

$$FI = \frac{V}{\sqrt{g * y_h}} = \frac{[0.667]}{[\sqrt{9.81 * 1.63}]} = 0.167 \prec 1.00 \ldots\ldots sub \ldots critical \ldots flow$$

$$R = \frac{A}{P} = \frac{72.64}{\left[20.84 + 2 * 2.663\sqrt{1 + (1.00)^2}\right]} = \frac{68.6133}{28.372} = 2.418$$

$$IR = \frac{V * R}{\upsilon} = \frac{(0.667) * (2.418)}{1 * 10^{-6}} = 1,612,806 \succ 2000 \ldots\ldots turbulent \ldots flow$$

Flow is sub critical turbulent

Question (2)

A)

-specific energy

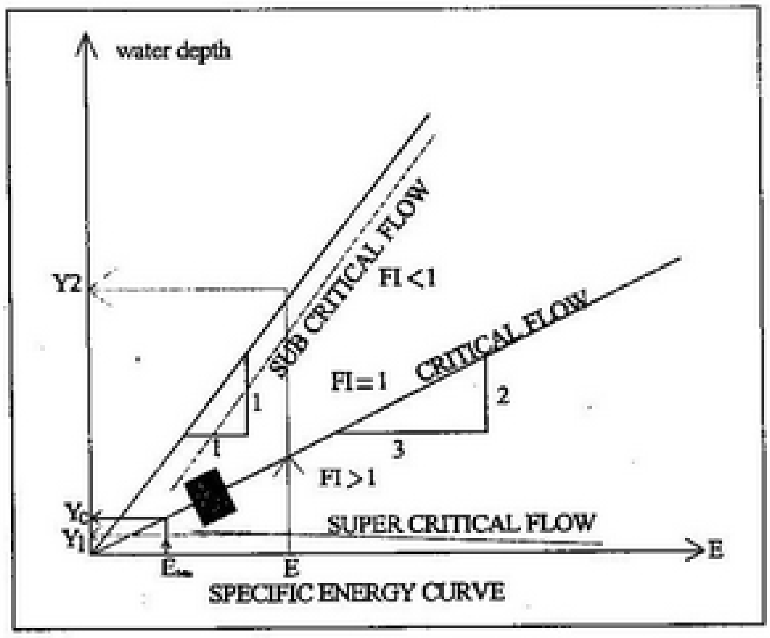
$$E = y + \frac{V^2}{2g} = y_2 + \frac{Q^2}{2 * g * A2^2}$$

-total specific energy

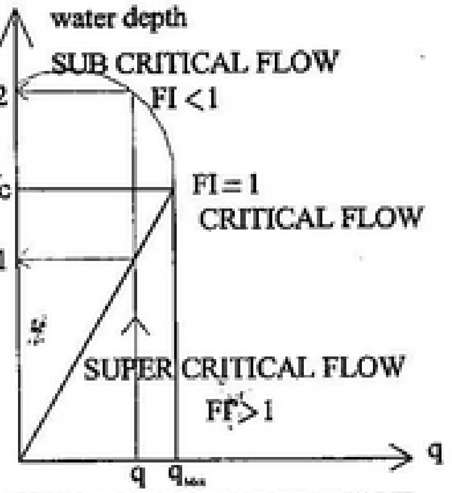
$$E = Z + y + \frac{V^2}{2g} = Z + y_2 + \frac{Q^2}{2 * g * A2^2}$$

-tow alternative depth

Its tow depths have the same specific energy and discharge one of them more than critical depth and occur in sub critical flow and other less than critical depth and occur in super critical flow



Specific energy diagram show relation between (E - Y) this curve draw under line slope 1: 1 (angle of 45°) .there are anther line draw by slope 3: 2 (critical depth line) at y_c occurs minimum specific energy (yc =1.50 E_{min}). If y less than y_c flow is super critical and If y more than yc flow is sub critical.



SPECIFIC DISCHARGE CURVE

Specific discharge diagram show relation between (q - Y) and at y_c occurs maximum specific discharge, if y less than y_c flow is super critical and if y more than yc flows is sub critical.

B)

Given

Q=23m/s & z =2

b =8.00m & y=2.75m

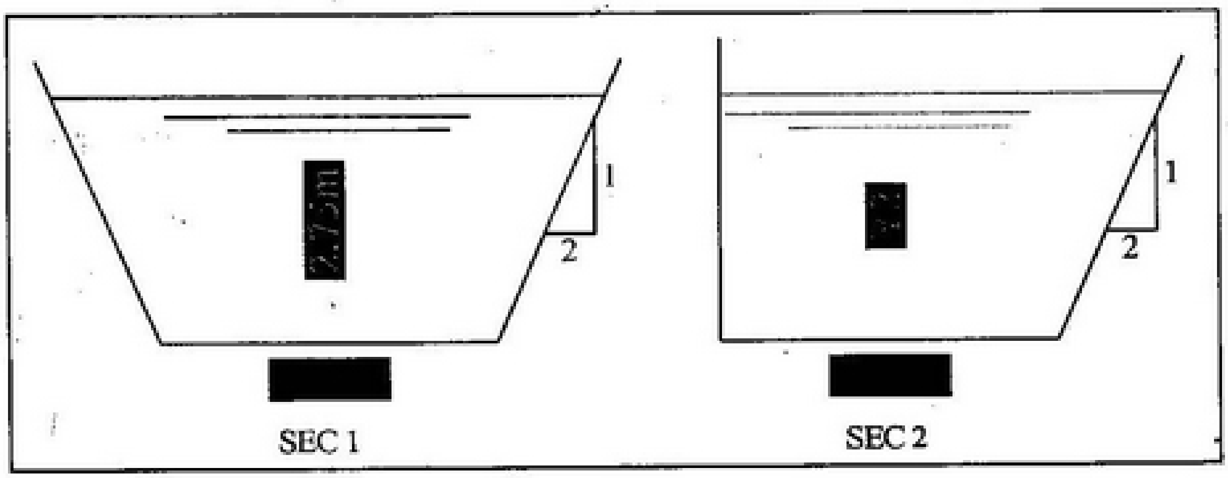
Trapezoidal section

Required

1-water depth at contraction

2-max height of hump

Solution



1) To get water depth

Applying energy equation between section 1 and section 2

E1=E2+h_L

By neglecting head lose

E1=E2

$$A = y(b + zy) = 2.75(8 + 2 * 2.75) = 37.125......m$$

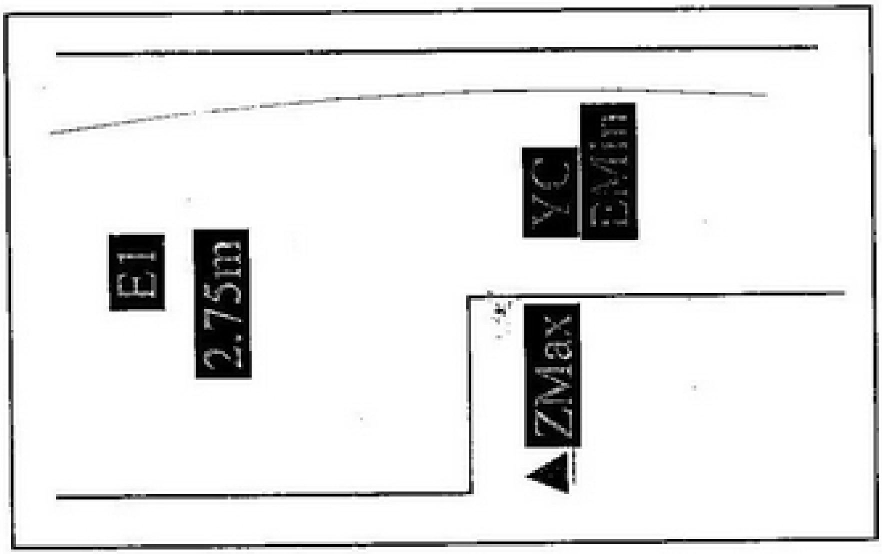
$$y1 + \frac{Q^2}{2g * A1^2} = y_2 + \frac{Q^2}{2 * g * A2^2}$$

$$2.75 + \frac{(23)^2}{2 * 9.81 * 37.125^2} = y_2 + \frac{23.00^2}{2 * 9.81 * (6y_2 + y_2{}^2)^2}$$

$$2.7696 = y_2 + \frac{26.962}{(6y_2 + y_2{}^2)^2}$$

By trial and error **Y_2=2.72m**

2- To get ΔZ_{max}



E1=Emin+ ΔZmax

$$y1+\frac{Q^2}{2g*A1^2}=E_{min}+\Delta Z_{MAX}$$

$$E_{min}=y_c+\frac{y_h}{2}$$

$$\frac{Q^2}{g}=\frac{A^3}{T} \qquad \frac{(23.00)^2}{9.81}=\frac{\left(6y_c+y_c^{\,2}\right)^3}{(6+2y_c)} \qquad 53.925=\frac{\left(6y_c+y_c^{\,2}\right)^3}{(6+2y_c)}$$

By trial and error ***Yc=1.075m***

$$y_h=\frac{A}{T}=\frac{\left(b*y_c+y_c^{\,2}\right)}{(b+2*y_c)} \qquad y_h=\frac{\left(6*1.075+(1.075)^2\right)}{(6+2*1.075)}=0.9332$$

$$E_{min}=y_c+\frac{y_h}{2}=1.075+\frac{0.9332}{2}=1.5416m$$

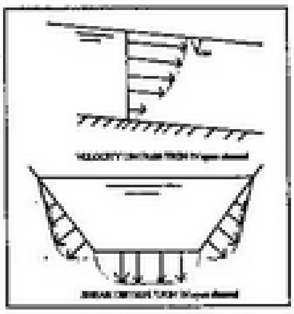
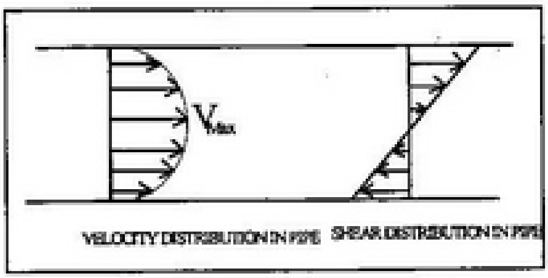
$$E_{min}=y_c+\frac{y_c(2.50+1.50y_c)}{2(2.50+2*1.50*y_c)}=2.00$$

$$y1+\frac{Q^2}{2g*A1^2}=E_{min}+\Delta Z_{MAX} \qquad 2.75+\frac{(23)^2}{2*9.81*37.125^2}=1.5416+\Delta Z_{max}$$

ΔZmax =1.2m

QESTION (3)

A)

<table>
<tr><th>Open channel</th><th>pipe</th></tr>
<tr><td>1-main force affecting on flow is inertia force and gravity force.
2-main dimensionless number described low is Froude number
3-natural or artificial
4-for IR≤500 flow is laminar
500<IR≤2000 flow is transitional
IR>2000 flow is turbulent
5-
Velocity distribution shear distribution
</td><td>1-main force affecting on flow is inertia force and viscosity force.
2-main dimensionless number described flow is Renold number
3- artificial
4-for IR≤200 flow is laminar
2000<IR≤4000 flow is transitional
IR>4000 flow is turbulent
5-
Velocity distribution shear distribution
</td></tr>
</table>

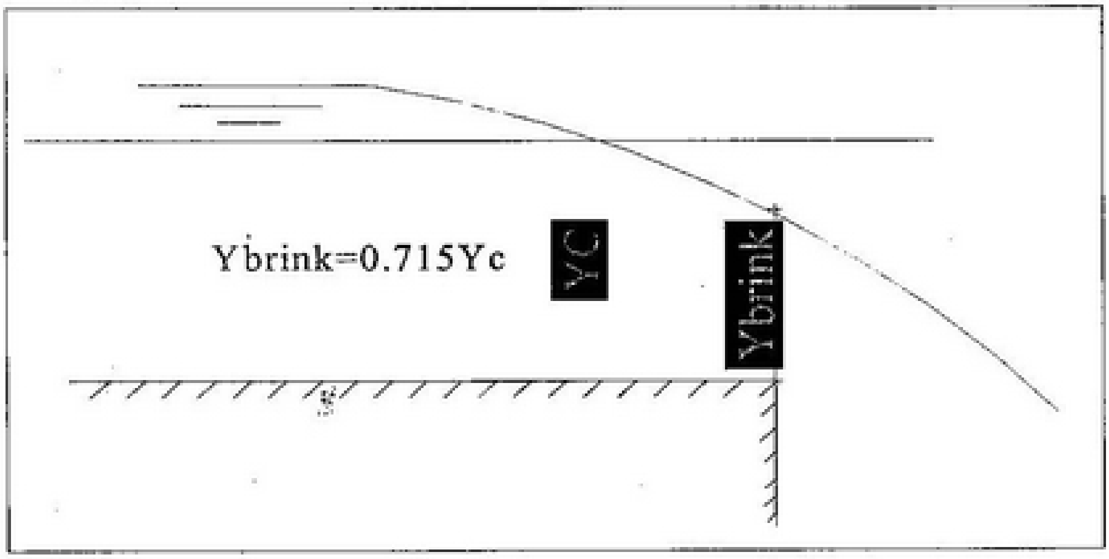
B)

-Tow conjugate depth

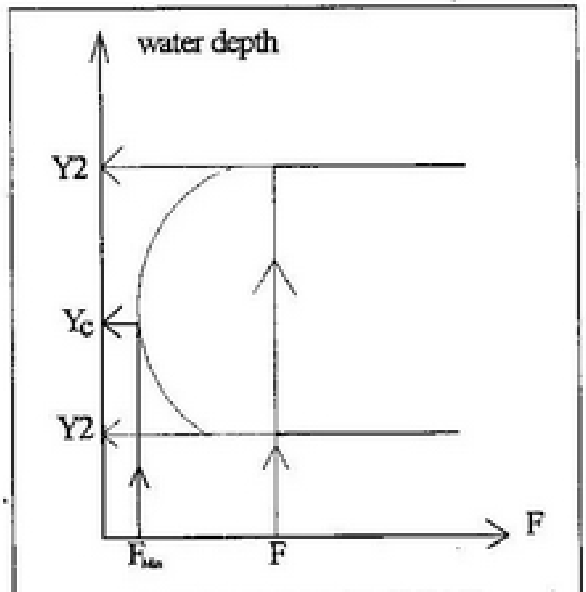
Its tow depts. h have the same specific force one of them more than critical depth and occur in sub critical flow and other less than critical depth and occur in super critical flow. And occur together.

-Control section

Its section at which water depth equal critical depth



-Specific force



SPECIFIC FORCE CURVE

Specific force diagram show relation between (F - y), y_c occurs at minimum specific force. If y less than yc flow is super critical and If y more than yc flow is sub critical. These tow depths called tow conjugate depth.

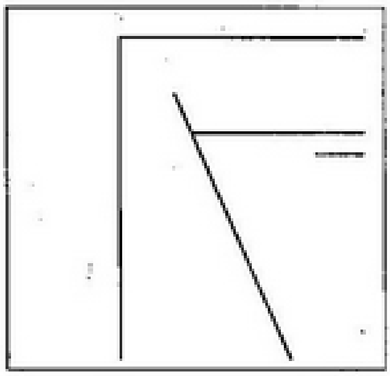
Given

YC=2.00m & So1=0.003188
So2=0.0921 & So3=0.0011262
B=4.00m & Z=2.00
Trapezoidal section

Required

1- tow conjugate depth
2- relative initial and sequent depth
3- jump losses and efficiency
4- jump length
5- drawing water surface profile

Solution



$$\frac{Q^2}{g} = \frac{A^3}{T}$$

$$\frac{Q^2}{9.81} = \frac{[y(b+zy)]^3}{b+2Zy} = \frac{(2(4+2*2))^3}{(4+2*2*2)}$$

Q=57.886m^3/s

$$Q=\frac{1}{n}*\frac{A^{\frac{5}{3}}}{P^{\frac{2}{3}}}*S^{\frac{1}{2}}\ldots m^3/_{sec}\ldots\ldots\ldots\ldots 57.866=\frac{1}{0.025}*\frac{\left[y_{n2}(4+2y_{n2})\right]^{\frac{5}{3}}}{\left(4+2y_{n2}\sqrt{1+(2)^2}\right)^{\frac{2}{3}}}*(0.0003188)^{\frac{1}{2}}$$

$$81.022=\frac{\left[y_{n2}(4+2y_{n2})\right]^{\frac{5}{3}}}{\left(4+2y_{n2}\sqrt{1+(2)^2}\right)^{\frac{2}{3}}}$$

$\underline{y_{n2}=4.00m}$

$$Q=\frac{1}{n}*\frac{A^{\frac{5}{3}}}{P^{\frac{2}{3}}}*S^{\frac{1}{2}}\ldots m^3/_{sec}\ldots\ldots\ldots\ldots 57.866=\frac{1}{0.025}*\frac{\left[y_{n2}(4+2y_{n2})\right]^{\frac{5}{3}}}{\left(4+2y_{n2}\sqrt{1+(2)^2}\right)^{\frac{2}{3}}}*(0.0921)^{\frac{1}{2}}$$

$$4.7669=\frac{\left[y_{n2}(4+2y_{n2})\right]^{\frac{5}{3}}}{\left(4+2y_{n2}\sqrt{1+(2)^2}\right)^{\frac{2}{3}}}$$

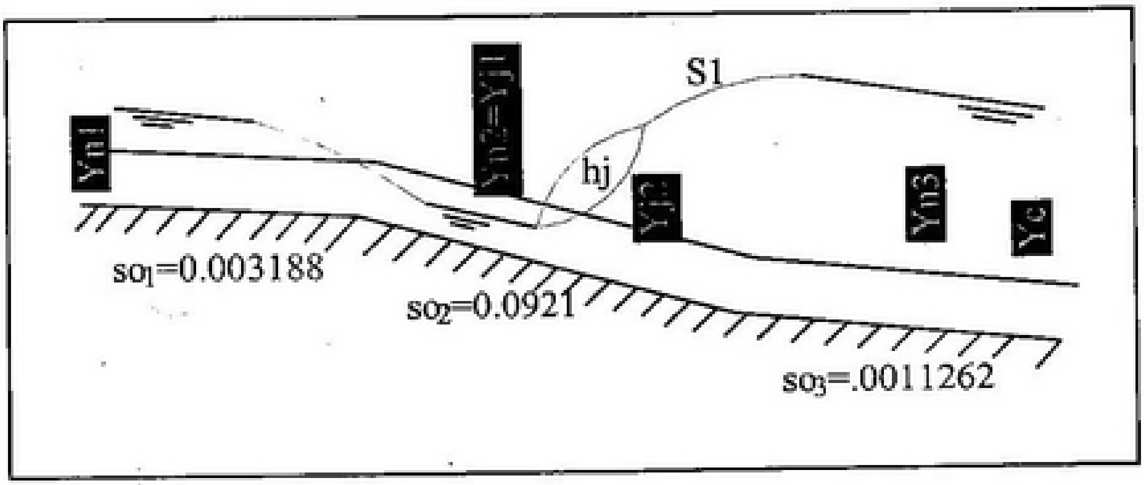
$\underline{y_{n2}=1.00m}$

$$Q=\frac{1}{n}*\frac{A^{\frac{5}{3}}}{P^{\frac{2}{3}}}*S^{\frac{1}{2}}\ldots m^3/_{sec}\ldots\ldots\ldots\ldots 57.866=\frac{1}{0.025}*\frac{\left[y_{n2}(4+2y_{n2})\right]^{\frac{5}{3}}}{\left(4+2y_{n2}\sqrt{1+(2)^2}\right)^{\frac{2}{3}}}*(0.0011262)^{\frac{1}{2}}$$

$$43.108=\frac{\left[y_{n2}(4+2y_{n2})\right]^{\frac{5}{3}}}{\left(4+2y_{n2}\sqrt{1+(2)^2}\right)^{\frac{2}{3}}}$$

$\underline{yn3=3.00m}$

<u>Assume S1 occur</u>



$$FI_1=\frac{V_1}{\sqrt{g*y_{n1}}}$$

$$V_1 = \frac{Q}{A_1} = \frac{57.866}{1.00(4+2*1.00)} = 9.644 m/s$$

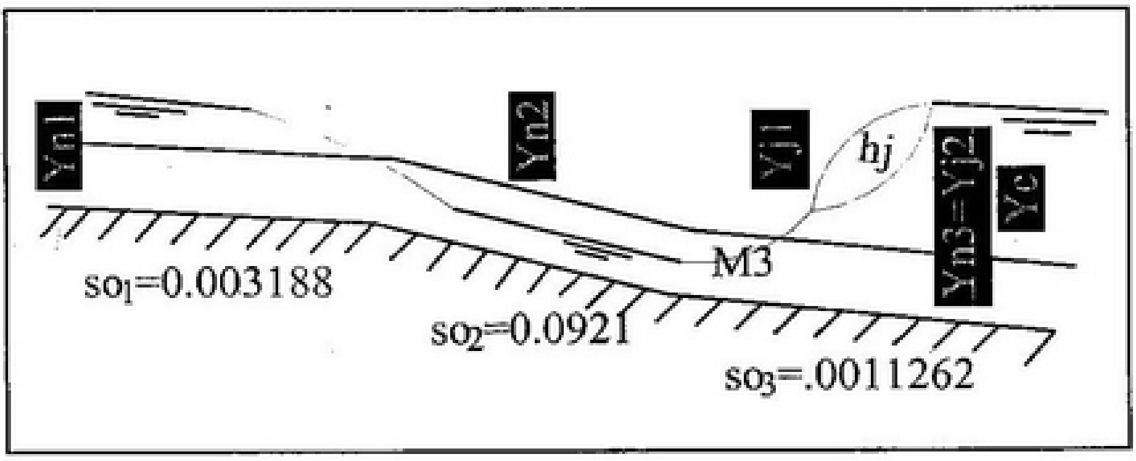
$$y_{h1} = \frac{A}{T} = \frac{1.00*(4+2*1.00)}{(4+2*2*1.00)} = 0.75m$$

$$FI_1 = \frac{9.644}{\sqrt{9.81*0.75}} = 3.556 \succ 1.00 \text{..............super...critical..flow}$$

$$\frac{y_2}{y_1} = \frac{1}{2}(\sqrt{1+8FI_1^2} - 1.00)$$

$$\frac{y_2}{1.00} = \frac{1}{2}(\sqrt{1+8*(3.556)^2} - 1.00)$$

$$y_{j2} = 4.554m \succ y_{n2} \text{...................} M_3 \text{....OCCUR}$$



Y2j=yn3=3.00m

$$FI_2 = \frac{V_2}{\sqrt{g*y_{h2}}}$$

$$V_2 = \frac{Q}{A_{21}} = \frac{57.866}{3.00(4+2*3.00)} = 1.929 m/s$$

$$y_{h2} = \frac{A_2}{T} = \frac{3.00*(4+2*3.00)}{(4+2*2*3.00)} = 1.875m$$

$$FI_2 = \frac{1.929}{\sqrt{9.81*1.875}} = 0.4498 \prec 1.00 \text{...............sub...critical..flow}$$

$$\frac{y_1}{y2}=\frac{1}{2}(\sqrt{1+8FI_2{}^2}-1.00)$$

$$\frac{y_1}{3.00}=\frac{1}{2}(\sqrt{1+8*0.4498^2}-1.00)$$

$$y_{j1}=0.927m$$

$$E_1=y_1+\frac{Q^2}{2g*A_1{}^2}=0.927+\frac{(57.866)^2}{2*9.81*[0.927(4+2*0.927)]^2}=5.427$$

$$E_2=y_2+\frac{Q^2}{2g*A_2{}^2}=3.00+\frac{(57.866)^2}{2*9.81*[3.00*(4+2*3.00)]^2}=3.019m$$

$$2-Relative..Initial...Depth=\frac{y_2}{E_1}=\frac{3.00}{6.74}=0.445$$

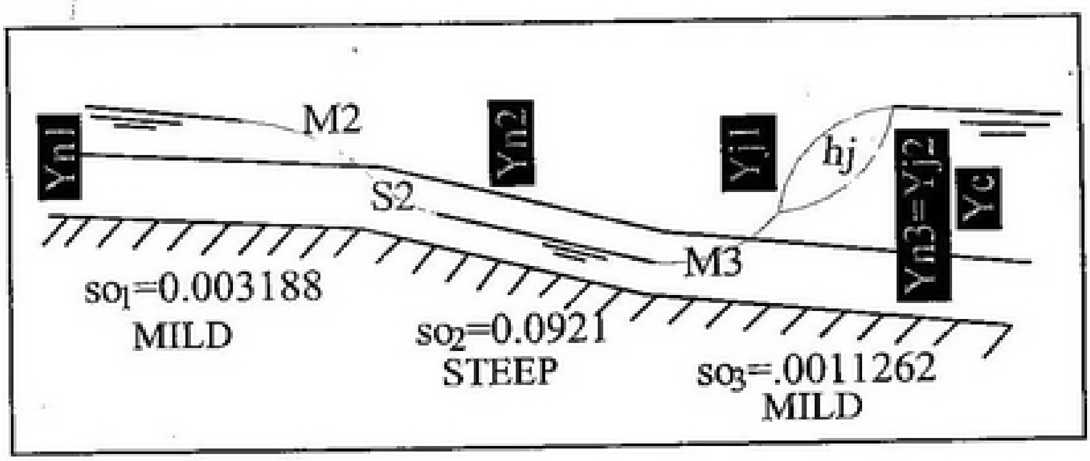
$$2-Relative..sequent...Depth=\frac{y_1}{E_1}=\frac{0.927}{6.74}=0.1375$$

$$3-head....losses........h_L=E1-E2=6.74-3.019=3.721m$$

$$3-efficiency....of.....jump=\frac{\gamma*Q*h_L}{75}=\frac{1000*57.866*3.721}{75}=2870.93HP$$

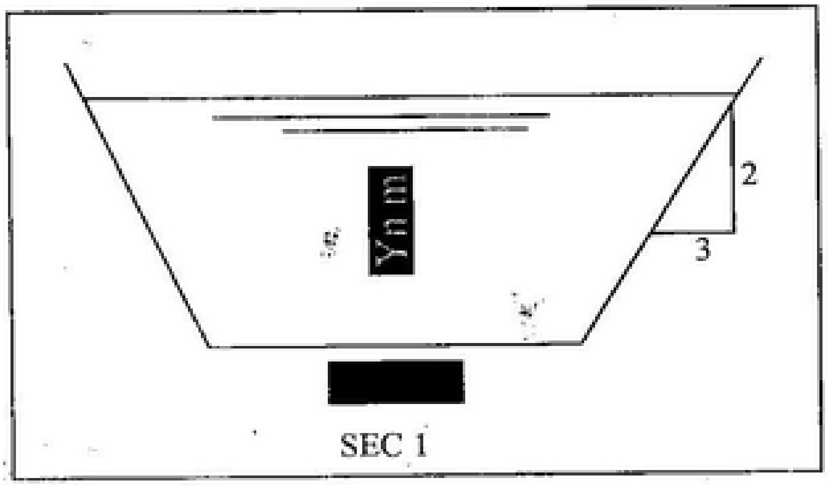
$$4-Lenght....of.....jump=5.20*hj=5.20*(3.00-0.926)=10.785m$$

5-Drawing



Given

S=0.009 & Q=450m3/s
n=0.025 & Z=1.50
Trapezoidal section



Required

1- S=0.009 km/km
=0.009*10^{-5}cm/km

S= 900cm/km

2-

$$Q=\frac{1}{n}*\frac{A^{\frac{5}{3}}}{P^{\frac{2}{3}}}*S^{\frac{1}{2}}\ldots m^3/\sec\ldots\ldots\ldots\ldots\ldots\ldots 450=\frac{1}{0.025}*\frac{\left[y_n(20+1.50y_{n2})\right]^{\frac{5}{3}}}{\left(20+2y_n\sqrt{1+(1.50)^2}\right)^{\frac{2}{3}}}*(0.009)^{\frac{1}{2}}$$

$$118.585=\frac{\left[y_n(20+1.50y_{n2})\right]^{\frac{5}{3}}}{\left(20+3.61y_n\right)^{\frac{2}{3}}}$$

By trial and error

Y_n=2.83m

$$3\text{-}\ y_h=\frac{A}{T}=\frac{2.83*(20+1.50*2.83)}{(20+2*1.50*2.83)}=\frac{68.6134}{28.49}=2.408m$$

Y_h=2.408m

4- $FI = \frac{V}{\sqrt{g * y_h}} = \frac{\left[450/68.6134\right]}{\left[\sqrt{9.81 * 2.408}\right]} = 1.349 \ldots\ldots\ldots\ldots super \ldots critical \ldots flow$

FI=1.349 flow super critical

5-

$$R = \frac{A}{P} = \frac{[68.6133]}{\left[20 + 2 * 2.83\sqrt{1 + (1.50)^2}\right]} = \frac{68.6133}{30.204} = 2.272$$

$$IR = \frac{V * R}{\upsilon} = \frac{\left(450/68.613\right) * (2.272)}{1 * 10^{-6}} = 14{,}900{,}966.29 \succ 2000 \ldots\ldots\ldots\ldots turbulent \ldots flow$$

IR=14,900,966.29 flow turbulent

Flow super critical turbulent

6-

$$\frac{Q^2}{g} = \frac{A^3}{T} \qquad \frac{(450)^2}{9.81} = \frac{\left[y_c(b + zy_c)\right]^3}{b + 2Zy_c} = \frac{(y_c(20 + 1.50 * y_c))^3}{(20 + 2 * 1.50 * y_c)}$$

$$20{,}642.20 = \frac{(y_c(20 + 1.50 * y_c))^3}{(20 + 2 * 1.50 * y_c)}$$

By trial and error

Y_c=3.403m>2.83 steep slope

7-

$$y_h = \frac{A}{T} = \frac{4.50 * (20 + 1.50 * 4.50)}{(20 + 2 * 1.50 * 4.50)} = \frac{120.375}{33.50} = 3.5932m$$

$$FI = \frac{V}{\sqrt{g * y_h}} = \frac{\left[450/120.375\right]}{\left[\sqrt{9.81 * 3.5932}\right]} = 0.6296 \prec 1.00 \ldots\ldots\ldots\ldots sub \ldots critical \ldots flow$$

FI=0.6296 flow sub critical

$$R = \frac{A}{P} = \frac{[120.375]}{\left[20 + 2 * 4.50\sqrt{1 + (1.50)^2}\right]} = \frac{120.375}{36.225} = 3.323$$

$$IR = \frac{V * R}{\upsilon} = \frac{\left(450/120.375\right) * (3.323)}{1 * 10^{-6}} = 12{,}422{,}429.29 \succ 2000 \ldots\ldots\ldots\ldots turbulent \ldots flow$$

R=12,422,429.29 flow turbulent
Flow sub critical turbulent

8-

Hydraulic jump occur U/S the weir

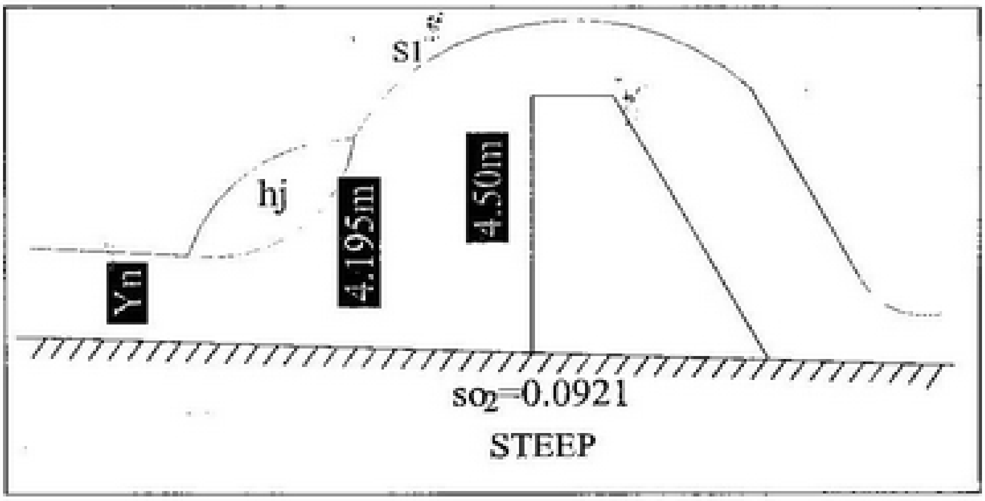
9-

Yj1=yn=2.83

10-

This slope is steep so

S1 occur



$$\frac{y_2}{y_1} = \frac{1}{2}\left(\sqrt{1+8FI_1^{\,2}} - 1.00\right)$$

$$\frac{y_2}{2.83} = \frac{1}{2}\left(\sqrt{1+8*(1.349)^2} - 1.00\right)$$

Y2=4.166m

11-

This slope is steep

12-

Water surface profile U/S the weir

13-

$$E_1 = y_1 + \frac{Q^2}{2g*A_1^{\,2}} = 4.195 + \frac{(450)^2}{2*9.81*[4.195(20+1.50*4.195)]^2} = 5.0435$$

E1=5.0435m

14-

$$E_2 = y_2 + \frac{Q^2}{2g*A_2^{\,2}} = 4.50 + \frac{(450)^2}{2*9.81*[4.50*(20+1.50*4.50)]^2} = 5.212m$$

E2=5.212m

15-

$$\Delta E = E_2 - E1 = 5.212 - 5.0435 = 0.1685m$$

<u>Δ E=0.1685m</u>

16-

$$Q = \frac{1}{n} * \frac{A^{\frac{5}{3}}}{P^{\frac{2}{3}}} * S^{\frac{1}{2}} ... m^3/_{sec} .... 450 = \frac{1}{0.025} * \frac{[y_n(20+1.50y_{n2})]^{\frac{5}{3}}}{\left(20+2y_n\sqrt{1+(1.50)^2}\right)^{\frac{2}{3}}} * (SO_1)^{\frac{1}{2}}$$

$$450 = \frac{1}{0.025} * \frac{[4.195(20+1.50*4.195)]^{\frac{5}{3}}}{\left(20+2*4.195\sqrt{1+(1.50)^2}\right)^{\frac{2}{3}}} * (SO_1)^{\frac{1}{2}}$$

$$450 = \frac{1}{0.025} * \frac{[110.29)]^{\frac{5}{3}}}{[35.125]^{\frac{2}{3}}} * (SO_1)^{\frac{1}{2}}$$

<u>SO1 =2.262*10</u>

$$Q = \frac{1}{n} * \frac{A^{\frac{5}{3}}}{P^{\frac{2}{3}}} * S^{\frac{1}{2}} ... m^3/_{sec} .... 450 = \frac{1}{0.025} * \frac{[y_n(20+1.50y_{n2})]^{\frac{5}{3}}}{\left(20+2y_n\sqrt{1+(1.50)^2}\right)^{\frac{2}{3}}} * (SO_2)^{\frac{1}{2}}$$

$$450 = \frac{1}{0.025} * \frac{[4.50(20+1.50*4.50)]^{\frac{5}{3}}}{\left(20+2*4.50\sqrt{1+(1.50)^2}\right)^{\frac{2}{3}}} * (SO_2)^{\frac{1}{2}}$$

$$450 = \frac{1}{0.025} * \frac{[120.375)]^{\frac{5}{3}}}{[36.225]^{\frac{2}{3}}} * (SO_2)^{\frac{1}{2}}$$

<u>SO2 =1.7614*10^{-3}</u>

SE_{AVE}= (SO1+ SO2)/2
*= (2.262*10^{-3}+1.7614*10^{-3})2*
*=2.0117*10^{-3}*

<u>SE_{AVE}=2.0117*10^{-3}</u>

17-

ΔS=S0- SE_{AVE}
*= ٠,٠٠1 - 2.0117*10^{-3}*
*=6.9983*10^{-3}*

$$\Delta x = \frac{\Delta E}{\Delta S} = \frac{01685}{6.9983*10^{-3}} = 24.078$$

$\Delta X = 24.00\ m$

18-

$$K=\frac{1}{n}*\frac{A^{\frac{5}{3}}}{P^{\frac{2}{3}}}...m^3/sec .... K=\frac{1}{0.025}*\frac{[2.83(20+1.50*2.83)]^{\frac{5}{3}}}{\left(20+2*2.83\sqrt{1+(1.50)^2}\right)^{\frac{2}{3}}}=4742.79\,m^3/sec$$

$K = 4742.79\ m^3/S$

١٩ -

$$A=[3.403(20+1.50*3.403)]=85.43m_2$$

$$y_h=\frac{A}{T}=\frac{85.43}{(20+2*1.50*3.403)}=\frac{85.43}{30.209}=2.828m$$

$$Z=A\sqrt{yh}=85.43*\sqrt{2.828}=143.664$$

Or

$$Z=\sqrt{\frac{Q^2}{g}}=\sqrt{\frac{430^2}{9.81}}=143.664m^{2.5}$$

$Z = 143.664 m^{2.5}$

NO	١	٢	٣	٤	٥	٦	٧	٨	٩	١٠	١١	١٢	١٣	١٤	١٥	١٦	١٧	١٨	١٩
answer	C	b	a	c	b	b	a	a	a	a	b	a	a	a	a	a	a	a	c